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REVIEW ARTICLE

Rapid implant therapies: immediate implant placement and immediate restoration

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Received: Nov 3, 2008
Accepted: Jan 20, 2009

KEY WORDS:

dental implants;
immediate implants;
immediate loading;
immediate restoration

During the last decade, the effectiveness of implant therapy has greatly improved, and the demands of dental esthetics in implant dentistry have become an important issue. The traditional two-stage implant protocol with delayed restoration has a treatment duration of 1–2 years, in which patients had to wear a removable appliance and experienced significant discomfort during the recovery period. Nowadays, immediate implant placement into an extraction site followed by immediate restoration of a dental implant can shorten the dental rehabilitation time and preserve patients' esthetic appearance at all stages of treatment. However, these treatment protocols always pose a great challenge to clinicians, especially when treating patients with preexisting soft and hard tissue deficiencies. The aim of this report is to present various treatment modalities to provide immediate tissue reconstruction and implant restoration following tooth extraction. With appropriate patient selection and careful clinical planning, these treatment strategies can lessen the number of surgeries required, condense treatment times, reduce discomfort to the patient, and accelerate the restoration process.

Introduction

Tooth replacement with a dental implant has proven to be a reliable and effective method of restoring edentulous dentition. Traditional dental implant placement protocols required preparation of the surgical site to establish intimate contact of the implant with the alveolar bone.¹ After tooth extraction, a 6-month healing period was recommended to allow bone to fill in the extraction socket before implant placement. In addition, a subsequent healing period of 3–6 months after fixture placement was indicated. Consequently, it usually took 1–2 years from the start of treatment to the completion of the restoration for most implant patients.²

This protocol could leave patients without teeth or with an uncomfortable temporary prosthesis for a long time during implant therapy. In recent decades, implant treatment protocols have been challenged, and new approaches aim to shorten the overall treatment period as follows: (1) immediate implant placement in extraction sockets; (2) immediate restoration following implant placement; (3) immediate implant restoration in extraction sockets; and (4) immediate implant restoration and immediate tissue reconstruction.

The aims of this article are to describe the various options available for rapid implant therapies and expand the clinical considerations, limitations and outcomes of different treatment modalities.

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Meanwhile, we also introduce an integrated treatment approach for immediate restoration in patients with a narrow edentulous ridge.

Immediate implant placement in extraction sockets

The progressive involution of the alveolar bone begins following tooth extraction, and it is usually accompanied by reductions in both the quality and quantity of hard tissue. It was shown that major changes in an extraction site occur in the first 3–12 months after tooth extraction, and an estimated 50% decrease in buccolingual width was demonstrated.³ Placing implants immediately after tooth extraction can eliminate the waiting period for socket healing and may reduce the bone resorption that normally occurs following the loss of a tooth.⁴

Although several longitudinal studies have shown that immediate implant placement after tooth extraction has a high clinical success rate exceeding 90%,^{5–8} some clinical considerations must be addressed. Immediate implantation may be contraindicated in the presence of acute periapical or periodontal lesions.^{9,10} The width of the peri-implant gap has a significant impact on the amount of bone-to-implant contact.^{11,12} Localized bony defects surrounding implants may influence their primary stability and make it difficult to achieve an ideal prosthesis. To enhance the primary stability, implants installed immediately should be stabilized using the surrounding socket wall and bone beyond the original root apex.¹³ It was shown that when the horizontal width of a peri-implant defect was <2mm, the defect had the capacity to spontaneously heal and produce new bone formation when immediate implant placement was performed.^{14–16} However, the gap between the implant and the socket wall can also be occupied by soft tissue.¹⁴

Recent studies indicated that immediate implant placement cannot completely preserve the entire bony wall surrounding an implant.^{17,18} Less bone filling and a greater reduction in the vertical bone height of the buccal plate were noted with larger peri-implant gaps.¹⁹ To enhance peri-implant bone healing and achieve an esthetic final outcome, the use of barrier membranes and/or different graft materials to fill in residual peri-implant defects has been widely documented.^{20–22} Barrier membranes may prevent connective tissue and epithelium from invading the gap between the implant and the surrounding bone walls, thereby favoring bone regeneration.^{23,24} Grafting materials can, moreover, act as a space maintainer and promote bone formation.^{22,25,26} Many studies have shown the successful use of various graft materials, including

autogenous grafts,^{8,27} freeze-dried bone allografts,^{6,28} xenografts^{22,26} and synthetic bone grafts,^{29,30} in the reconstruction of peri-implant defects in cases of immediate implant placement. However, few researchers have compared clinical outcomes among different graft materials for immediate implant placement. Recently, Hassan et al.³¹ demonstrated less marginal bone loss with an autogenous bone graft than with a synthetic bone graft in immediate implant placement treatment. Additional controlled studies are needed to verify the effectiveness of these grafting materials. While the use of ePTFE non-absorbable membranes for immediate implant surgery showed a better space-making effect and encouraged more bone filling,^{27,32} many surgeons have experienced high percentages (39–67%) of premature membrane exposure.^{6,21,33,34} The exposed membranes can become contaminated by microorganisms,^{35,36} which increases the risk of infection, and hinders bone regeneration of the defects.^{37,38} Therefore, delayed-type immediate implant placement has been proposed to obtain better flap management for wound closure at extraction sites.³⁹ According to the delayed-type protocols, implants are placed several weeks after tooth extraction to allow soft tissue healing.^{40,41} Delayed-type immediate implant placement exhibited a lower incidence of soft tissue dehiscence during guided bone regeneration compared with immediately placed implants.⁴²

Immediate restoration following implant placement

One of the paradigms for successful implant therapy is a non-loading period of 3–6 months following fixture installation to achieve osseointegration. This waiting period is inconvenient for patients because of the delay in final restoration. Recently, techniques in which implants are placed with provisional restoration on the day of surgery have been developed.^{43–45} With an immediate restoration protocol, patients require no additional surgery for implant uncovering procedures, and thus benefit from not having to wear removable or bonded provisional restorations during the treatment period.

Immediate restoration refers to immediate loading, in which prosthetic loading occurs within the first few days of implant placement. Such implants can remain unloaded during the initial healing period, especially in patients with a compromised bone condition.^{46,47} Although many reports used the words “immediate loading” to describe immediate provisional prosthesis placement on the day of implant installation, the implants in most of those studies were not subjected to direct functional loading,

since the provisional restorations were carefully relieved of both centric and excursive occlusal contacts. It is, therefore, improper to describe these implants as being immediately loaded. A more accurate description for this circumstance would be “immediately restored”, which is adopted in this article. Advocating an immediate restoration strategy requires adequate bone volume and a soft tissue contour to achieve primary stability of the implant and an optimal esthetic outcome of the implant prosthesis. Although the immediate restoration of implants can be highly successful,^{48–50} such implants may fail in areas where the bone is soft and in patients with problems of wound healing. Patients with diabetes or habits of heavy smoking or bruxism need to be strictly screened.⁵¹

Recently, immediate restorations have been expanded and applied to the restoration of single missing teeth in the maxillary anterior region. These immediately restored prostheses can act as a scaffold to support the adjacent mucosa and papillae, thus facilitating the creation and maintenance of the soft tissue profile around implants. These immediate restoration cases with unsplinted implants had survival rates ranging from 80% to 100%. In those studies, some of the implants were placed in healed ridges,^{52–54} while others were placed in immediate extraction sites.^{55–57}

Immediate implant restoration in extraction sockets

To expedite the overall implant treatment course after tooth extraction, more recent efforts have focused on the feasibility of tooth replacement using immediate provisional implant restorations which are placed in extraction sites. Many early studies on immediate loading of restorations mostly dealt with the edentulous mandible, where the bone density is favorable, and it is possible to perform cross-arch splinting to minimize micromovement of the implant during the healing period.^{46,58} Recently, some preliminary studies reported that such immediate restorations can also be applied to single-tooth replacement^{56,57} and short-span partial edentulous rehabilitation.^{58–60}

Obviously, in some patients, significant time can be saved and multiple clinic visits avoided by simultaneously extracting a tooth, placing an implant, and restoring the prosthesis. However, it has been demonstrated that immediately restored implants placed in fresh extraction sites carry a higher risk of failure.^{55,58,61} Chaushu et al.⁵⁵ studied a group of 26 immediately restored single-tooth implants and found that three of 17 (17.6%) implants placed in extraction sockets failed, while all implants placed

in healed ridges survived. They indicated that immediate restoration of single-tooth implants placed in fresh extraction sites carry an approximate risk of failure of 20%. Clinical investigations by Malo et al.⁶¹ and Degidi and Piattelli⁵⁸ did not specifically report survival rates after implantation into extraction sockets versus healed ridges; yet, they noted that all implant failures occurred in cases of immediate implantation into extraction sockets. It has also been demonstrated that roughened-surface implants have higher implant survival rates than those of machined-surface implants.^{62,63} To optimize results of such implants, the use of rough-surface implants is advised, and immediate restoration should only be performed in cases with primary stability. In these patients, the potential for implant micromovement is minimized by avoiding any centric and eccentric contacts.^{54,58,59} In addition, a soft diet and extra oral hygiene care are recommended.^{53,56}

Immediately restored implants placed in extraction sockets use a non-submerged protocol. Another adverse event associated with such an implant installation is undesirable recession of the peri-implant soft tissue. During the healing period of immediate implants placed in extraction sites, the buccal crestal bone undergoes remodeling and resorption, which may result in the buccal plate having insufficient height and/or thickness,^{17,18} with subsequent soft tissue recession.^{26,64} Chen et al.²⁶ placed 30 immediate transmucosal implants in maxillary anterior extraction sites, and 33.3% of the implants exhibited recession of the mucosa after 6 months. This problem is especially important for patients with a thin biotype. Since the buccal bony plate underneath the thin gingival tissue is also generally thin, it is prone to resorption following tooth extraction and implant surgical procedures. For a more favorable esthetic outcome, tissue reconstruction should always be considered in restoration of immediate extraction cases.^{5,65}

Immediate implant restoration and immediate tissue reconstruction

Immediate restoration during implant placement is always a challenge for clinicians, because patients requesting implant treatment frequently present with an insufficient bony height and/or thickness following tooth removal. Numerous procedures have been devised to compensate for the narrow ridge of implant recipient sites.^{66,67} A simultaneous or staged approach of implant installation with guided bone regeneration has extensively been used to create new bone.^{2,68,69} When implant placement is combined with guided bone regeneration, two-stage implant surgery is highly recommended.

Although reports have shown clinical success in regenerating peri-implant defects when a non-submerged approach is used in conjunction with bone grafts or barrier membranes,^{26,70,71} results are thought to be strongly dependent on the technical skills of the surgeon. For immediate implant restoration cases with a compromised ridge, a novel technique combining immediate temporization with simultaneous tissue reconstruction using ridge expansion and soft tissue augmentation to restore preexisting soft and hard tissue deficiencies was developed.⁷² The major procedures consist of expanding the ridge during implant site preparation, harvesting a connective tissue graft for rebuilding the soft tissue contour in the edentulous area, and providing an immediate prosthesis. With ridge expansion, a set of tapered osteotome hand instruments is used to expand the narrow ridge and simultaneously create a site for implant installation. The use of an osteotome for implant site preparation can conserve all the remaining bone by pushing bone in front of the osteotome rather than removing valuable bone, which occurs when conventional drilling is performed. The osteotome technique expands the ridge in a gradual and controlled fashion until an accurate shape is attained. This shape widens the ridge in a gentle manner, such that a barrier membrane and bone graft may not be needed. By using the osteotome ridge-expansion technique, ridge augmentation and implant placement can simultaneously be performed. Therefore, immediate implant restoration can potentially be attained. This all-in-one integrated treatment approach (ridge widening, soft tissue augmentation, and provisional prosthesis delivery) simplifies the overall implant procedure, and can be adopted for patients with a narrow recipient ridge who request immediate implant restoration.

Conclusion

With careful patient selection and deliberate treatment planning, different strategies of immediate implant placement and/or immediate restoration have shown promising results in providing reconstruction of the dentoalveolar complex in a one-stage approach. These protocols benefit patients by reducing surgical procedures and the healing period, decreasing the time when they are toothless, and increasing patient acceptance of dental rehabilitation following tooth extraction.

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